

WHAT IS CLAIMED IS:

1. A liquid drop emitter comprising:
 - (a) a chamber, formed in a substrate, filled with a liquid and having a nozzle for emitting drops of the liquid;
 - (b) a thermo-mechanical actuator, extending into the chamber from at least one wall of the chamber, and having a movable element residing in a first position proximate to the nozzle;
 - (c) the movable element having a bending portion which bends when heated, the bending portion having at least one actuator opening for passage of the liquid; and
 - (d) apparatus adapted to apply heat pulses to the bending portion actuator resulting rapid deflection of the movable element to a second position, ejection of a liquid drop, and passage of liquid through the at least one actuator opening.
2. The liquid drop emitter of claim 1 wherein the liquid drop emitter is a drop-on-demand ink jet printhead and the liquid is an ink for printing image data.
3. The liquid drop emitter claim 1 wherein the thermo-mechanical actuator includes a deflector layer constructed of a deflector material having a high coefficient of thermal expansion and a low expansion layer, attached to the deflector layer, constructed of a low expansion material having a low coefficient of thermal expansion.
4. The liquid drop emitter claim 3 wherein the deflector material is electrically resistive and the apparatus adapted to apply a heat pulse includes a resistive heater formed in the deflector layer.

5. The liquid drop emitter claim 4 wherein the deflector material is titanium aluminide.

6. The liquid drop emitter of claim 1 wherein the movable element is an elongated structure having a lengthwise axis and the at least one actuator opening is substantially symmetric about the lengthwise axis.

7. The liquid drop emitter of claim 1 wherein the nozzle has a cross sectional area A_n for passage of the liquid, the movable element has one or more actuator openings having a total cross sectional area A_m for passage of the liquid, wherein $A_n < A_m < 10A_n$.

8. A liquid drop emitter comprising:

(a) a chamber, formed in a substrate, filled with a liquid and having a nozzle for emitting drops of the liquid;

(b) a thermo-mechanical actuator, having a cantilevered element extending from an anchor wall of the chamber and a free end residing in a first position proximate to the nozzle;

(c) the cantilevered element having a bending portion which bends when heated, the bending portion having at least one actuator opening for passage of the liquid; and

(d) apparatus adapted to apply heat pulses to the bending portion actuator resulting rapid deflection of the free end to a second position, ejection of a liquid drop, and passage of liquid through the at least one actuator opening.

9. The liquid drop emitter of claim 8 wherein the liquid drop emitter is a drop-on-demand ink jet printhead and the liquid is an ink for printing image data.

10. The liquid drop emitter claim 8 wherein the thermo-mechanical actuator is a laminate including a deflector layer constructed of a

deflector material having a high coefficient of thermal expansion and a low expansion layer, attached to the deflector layer, constructed of a low expansion material having a low coefficient of thermal expansion.

11. The liquid drop emitter claim 10 wherein the deflector material is electrically resistive and the apparatus adapted to apply a heat pulse includes a resistive heater formed in the deflector layer.

12. The liquid drop emitter claim 11 wherein the deflector material is titanium aluminide.

13. The liquid drop emitter of claim 11 wherein the resistive heater is configured to have a first resistor segment and a second resistor segment each extending from the anchor wall and the at least one actuator opening is located between the first and second resistor segments.

14. The liquid drop emitter of claim 13 wherein the at least one actuator opening includes slot portions that define a central stationary portion of the cantilevered element that does not bend when the bending portion is heated.

15. The liquid drop emitter of claim 14 wherein the anchor wall of the chamber has an upper anchor wall portion and the upper anchor wall portion is extended along the central stationary portion of the cantilevered element.

16. The liquid drop emitter of claim 14 wherein the thermal conductivity of the deflector material is substantially greater than the thermal conductivity of the low expansion material and the low expansion material is removed in the central stationary portion of the cantilevered element.

17. The liquid drop emitter of claim 14 wherein the thermal conductivity of the low expansion material is substantially greater than the thermal

conductivity of the deflector material and the deflector material is removed in the central stationary portion of the cantilevered element.

18. The liquid drop emitter of claim 14 wherein the substrate further includes a heat sink portion and a third material having high thermal conductivity is laminated to the central stationary portion and brought into good thermal contact with the heat sink portion.

19. The liquid drop-emitter of claim 8 wherein the nozzle has a cross sectional area A_n for passage of the liquid, the cantilevered element has one or more actuator openings having a total cross sectional area A_m for passage of the liquid, wherein $A_n < A_m < 10A_n$.

20. A liquid drop emitter comprising:

(a) a chamber, formed in a substrate, filled with a liquid and having a nozzle for emitting drops of the liquid;

(b) a thermo-mechanical actuator, having a beam element extending from opposite first and second anchor walls of the chamber and a central fluid displacement portion residing in a first position proximate to the nozzle;

(c) the beam element having bending portions adjacent the first and second anchor walls that bend when heated, the bending portions having at least one actuator opening for passage of the liquid; and

(d) apparatus adapted to apply heat pulses to the bending portions resulting rapid deflection of the central fluid displacement portion to a second position, ejection of a liquid drop, and passage of liquid through the at least one actuator opening.

21. The liquid drop emitter of claim 20 wherein the liquid drop emitter is a drop-on-demand ink jet printhead and the liquid is an ink for printing image data.

22. The liquid drop emitter claim 20 wherein the thermo-mechanical actuator is a laminate including a deflector layer constructed of a deflector material having a high coefficient of thermal expansion and a low expansion layer, attached to the deflector layer, constructed of a low expansion material having a low coefficient of thermal expansion.

23. The liquid drop emitter claim 22 wherein the deflector material is electrically resistive and the apparatus adapted to apply a heat pulse includes a resistive heater formed in the deflector layer.

24. The liquid drop emitter claim 23 wherein the deflector material is titanium aluminide.

25. The liquid drop emitter of claim 20 wherein the beam element is an elongated structure having a lengthwise axis, a beam center equidistant from first and second anchor walls, and first and second actuator openings that are substantially symmetric about the lengthwise axis and that are substantially symmetric with each other about the beam center.

26. The liquid drop emitter of claim 25 wherein the first and second actuator openings include slot portions that define first and second stationary portions of the beam element adjacent first and second anchor walls, said first and second stationary portions not bending when the bending portions are heated.

27. The liquid drop emitter of claim 26 wherein the first anchor wall of the chamber has an upper first anchor wall portion, the second anchor wall of the chamber has an upper second anchor wall portion, and the upper first anchor wall portion is extended along the first stationary portion of the beam element and the upper second anchor wall portion is extended along the second stationary portion of the beam element.

28. The liquid drop emitter of claim 26 wherein the thermal conductivity of the deflector material is substantially greater than the thermal conductivity of the low expansion material and the low expansion material is removed in the first and second stationary portions of the beam element.

29. The liquid drop emitter of claim 26 wherein the thermal conductivity of the low expansion material is substantially greater than the thermal conductivity of the deflector material and the deflector material is removed in the central stationary portion of the cantilevered element.

30. The liquid drop emitter of claim 26 wherein the substrate further includes a first and second sink portions and a third material having high thermal conductivity is laminated to the first and second stationary portions and brought into good thermal contact with the first and second heat sink portions, respectively.

31. The liquid drop emitter of claim 20 wherein the nozzle has a cross sectional area A_n for passage of the liquid, the beam element has one or more actuator openings having a total cross sectional area A_m for passage of the liquid, wherein $A_n < A_m < 10A_n$.